U. S. FOREST SERVICE
RESEARCH NOTE PSW- 161

PACIFIC SOUTHWEST
FOREST & RANGE EXPERIMENT STATION
1967 P.O. Box 245 Berkeley, California 94701

INTERMOUNTAIN STATION
Central Reference File
No. 0.73

Insecticides Tested on New Tussock Moth . . .

defoliator found in Montana

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ABSTRACT: A pine tussock moth--identified as *Dasychira* sp. near /=*grisefacta*--was found for the first time in Montana in 1965. Larvae were reared on ponderosa pine foliage in the laboratory. Six insecticides were tested by topical application on fourth-instar larvae. Contact toxicity at LD_{90}, in descending order, was as follows: pyrethrins, Zectran, malathion, DDT, SD-8530, and carbaryl.

OXFORD: 453--414:(786)

RETRIEVAL TERMS: tussock moth; DDT; Zectran; carbaryl; malathion; pesticide preparation; insect damage control; *Dasychira* sp. near /=*grisefacta*; *Pinus ponderosa* Laws; Montana.

In 1965, a tussock moth identified[1] as *Dasychira* sp. near/=*grisefacta* Dyar was recorded for the first time in eastern Montana.[2] The insects had defoliated 42,000 acres of ponderosa pine (*Pinus ponderosa* Laws.). Surveys[3] the year after the insects were discovered showed the outbreak had diminished considerably--possibly because of a nuclear polyhedrosis virus[4] that had been noted in rearings in Montana. The virus had also been found in the samples sent to this Station for study. In the laboratory, we tested six insecticides on this tussock moth. The results reported can be useful in the future selection of a chemical for field testing.

Field tests on a different but similar tussock moth in Wisconsin (*D. plagiata* (Walker)) showed that DDT was effective on spring larvae that had overwintered.[5,6] Dibrom and phosphamidon showed some promise applied in late summer on early instar larvae before overwintering.[5]

Test Insects

We know of no published description of the biology or morphology of this insect. But many of its characteristics will probably prove to be similar to those of the pine tussock moth (*D. plagiata*).[7]

Overwintering second-instar larvae were collected in eastern Montana and shipped by air express[8] during January, February, and March 1967 to the Station's quarantine facility at Berkeley, California.[9] We reared them on fresh-cut, unwatered ponderosa pine foliage held in gallon-size, cylindrical cardboard containers. The containers were

[1] Identified by Dr. E. L. Todd, U.S. Agricultural Research Service, Beltsville, Md., from specimens provided by the Branch of Pest Control, Northern Region, U.S. Forest Service, Missoula, Mont.

[2] U.S. Forest Service. *Forest insect conditions in the United States--1965.* 47 pp., illus. 1966.

[3] U.S. Forest Service. *Forest insect conditions in the United States--1966.* 42 pp., illus. 1967.

[4] Identified by Gerard Thomas, University of California, Division of Entomology, Berkeley, Calif.

[5] Walgenbach, David Darrell. *The biology and ecology of the pine tussock moth.* 1965. (Unpublished Ph.D. thesis on file at University of Wisconsin, Madison.)

[6] Banash, S. E., Benjamin, D. M., Morse, F. S., and others. *Evaluation of selected insecticides for the control of the pine tussock moth.* North Cent. Br. Entomol. Soc. Amer. Proc. 18:70. 1963.

[7] Walgenbach, Op. cit.

[8] We gratefully acknowledge the generous assistance by personnel of the Division of State and Private Forestry, Northern Region, U.S. Forest Service, Missoula, Mont., for providing test insects.

[9] With prior approval of the U.S. Department of Agriculture's Plant Quarantine Division and the California Bureau of Plant Quarantine.

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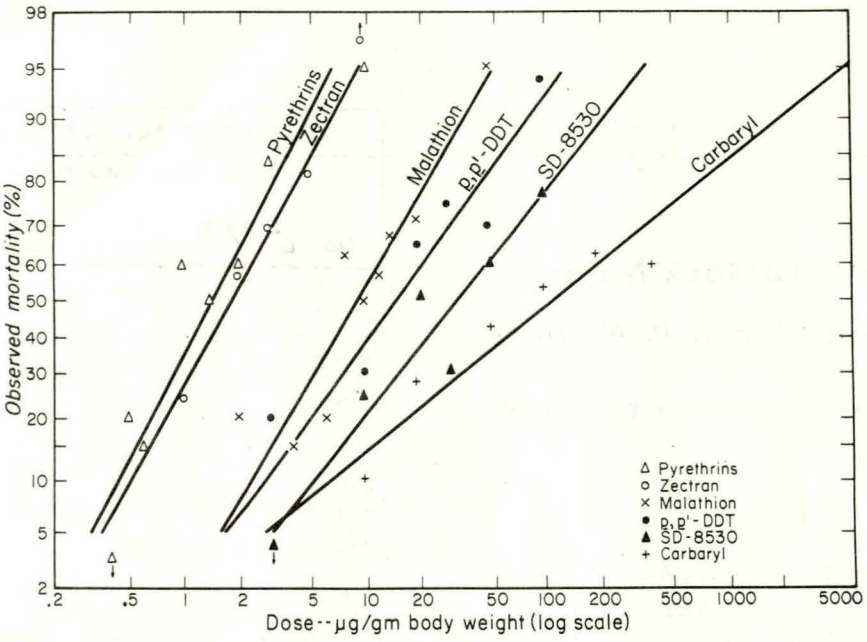

Figure 1.--*Relation of dosage to mortality resulting from six insecticides applied topically to the fourth-instar of* Dasychira *sp. near/=grisefacta* Dyar.

closed with 40-mesh nylon netting, held in place by the rim of the container cover--its center disk removed. The insects were transferred to fresh foliage about twice each week. We used foliage because of an unsuccessful attempt in 1966 to rear this insect on an artificial diet as we were able to do in similar tests on a different tussock moth from New Mexico.[10]

The insects were reared to the fourth instar which averaged 20.3 mg (based on 1,870 test insects) before being used for testing. Head capsule measurements were made of the larval instars (table 1) which were then preserved as a visual guide for the selection of the fourth instar.

Testing Procedure

The larvae were treated by topical application and held for post-treatment observations using procedures previously described.[11] The insects were fed ponderosa pine foliage after treatment instead of an artificial diet. The six candidate insecticides (table 2) were formulated in acetone solution the same day tested and were discarded immediately after using. Mortality was determined 3 days after treatment.

Results and Discussion

The six insecticides showed the following descending order of toxicity: pyrethrins, Zectran, malathion, p,p'-DDT, SD-8530, and carbaryl (table 3; fig. 1). In comparing these findings with those from previous tests on two other tussock moths belonging to the genus *Hemerocampa*, we noted some important differences in activity (table 4).

Pyrethrins were very toxic to all three species but cannot compete with the other materials on a dosage-cost basis.

The toxicity of Zectran to the pine tussock moth was especially high, relative to DDT, making it a highly desirable candidate for further evaluation and possible field testing on this species. It has already shown its effectiveness in the field against

[10] Flake, Harold W., Jr., and Lyon, Robert L. *Insecticide tests against larvae of Hemerocampa, new species, a tussock moth that defoliates boxelder in New Mexico.* J. Econ. Entomol. 60(2):607-608. 1967.

[11] Flake and Lyon, Op cit.

Table 1.--*Head-capsule measurements of larvae of Dasychira sp. near/=grisefacta Dyar from eastern Montana*

Instar	Insects measured	Width of head capsule	Range
	No.	*Mm.*	*Mm.*
1	7	0.79	0.75-0.85
2	7	1.08	1.00-1.15
3	7	1.29	1.24-1.34
4	5	1.67	1.53-1.87
5	6	1.84	1.70-1.96
6	5	2.06	1.99-2.21

Table 2.--*Purity and source of six candidate insecticides tested on larvae of Dasychira sp. near/=grisefacta Dyar from eastern Montana*

Common name	Chemical name	Purity	Source[1]
		Pct.	
Pyrethrins	Esters of chrysanthemum mono- and dicarboxylic acids	20	FMC Corp.
Zectran	4-dimethylamino-3,5-xylyl methylcarbamate	99+	Dow Chemical Co.
Malathion	Diethyl mercaptosuccinate, S-ester with 0,0-dimethyl phosphorodithioate	95+	American Cyanamid Co.
p,p'-DDT	1,1,1-trichloro-2,2-bis (p-chlorophenyl) ethane	100	City Chemical Corp.
SD-8530	3,4,5-trimethylphenyl methylcarbamate	100	Shell Chemical Co.
Carbaryl	1-naphthyl methylcarbamate	98	Union Carbide Corp.

[1] Trade names and commercial enterprises or products are mentioned solely for necessary information. No endorsement by the U.S. Department of Agriculture is implied.

Table 3.--*Mortality from six insecticides applied topically in acetone solutions to the fourth-instar of Dasychira sp. near/=grisefacta Dyar*

Insecticide	Insects treated		Observed 3-day kill at concentration of (µg/µl)[1]																					
	No.	Av. wt.	0	.02	.025	.03	.035	.05	.07	.1	.15	.2	.25	.3	.4	.5	.6	.7	1.0	1.5	2.5	5	10	20
		Mg.	*Percent*																					
Pyrethrins	210	22	-	0	20	15	-	60	50	60	83	-	-	-	-	95	-	-	-	-	-	-	-	-
Zectran	270	17	-	-	-	-	0	24	-	57	70	-	83	-	-	100	-	-	-	-	-	-	-	-
Malathion	280	19	-	-	-	-	-	-	-	20	-	15	-	20	62	50	57	68	72	-	95	-	-	-
p,p'-DDT	290	20	-	-	-	-	-	15	-	-	20	-	-	-	-	30	-	-	65	75	70	94	-	-
SD-8530	290	20	-	-	-	-	-	23	-	-	0	-	-	-	-	24	-	-	50	30	60	77	-	-
Carbaryl	260	21	-	-	-	-	-	5	-	-	-	-	-	-	-	10	-	-	28	-	42	53	62	60
Acetone	270	23	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[1] Volume administered was 1 µl/50 mg. body weight; concentration refers to the active ingredient.

Table 4.--*LD_{90} in µg/gm body weight and toxicity index for six insecticides applied to fourth-instar larvae of three species of tussock moth*

Insecticide	Pine tussock moth		Tussock moth from New Mexico[1]		Douglas-fir tussock moth[2]	
	LD_{90}	T.I.[3]	LD_{90}	T.I.[3]	LD_{90}	T.I.[3]
Pyrethrins	4.60	1826	0.346	7630	0.66	1636
Zectran	6.80	1235	8.48	311	7.65	141
Malathion	36.0	233	4550	0.58	2534	0.42
p,p'-DDT	84.0	100	26.4	100	10.8	100
SD-8530	200	42	27.8	95	21.3	51
Carbaryl	2000	4.2	57.7	46	83.7	13

[1] See footnote 10 in text.

[2] *Hemerocampa pseudotsugata* McDunnough; data from manuscript in preparation.

[3] T.I. = toxicity index based on p,p'-DDT at 100; $\frac{\text{p,p'-DDT } LD_{90}}{\text{Candidate insecticide } LD_{90}} \times 100$ = toxicity index.

the spruce budworm, *Choristoneura occidentalis* Freeman.[12]

The activity of malathion was strongly specific to the pine tussock moth. It was more toxic to this insect than to the *Hemerocampa* species: LD_{90} of 36.0 vs. > 2,000 µg./gm. body weight, and a toxicity index of 233 vs. ca. 0.5. This finding demonstrates how important laboratory testing on the target species may be before selecting compounds for field testing.

Carbaryl was moderately toxic on th *Hemerocampa* tussock moth. On this bas alone it most certainly would have bee favored over malathion for field testi on the pine tussock moth. In fact whe carbaryl was tested on the closely related tussock moth *D. plagiata* in Wisconsin it proved to be ineffective.[13]

[12]U.S. Forest Service. *Zectran--for control of spruce budworm.* 6 pp., illus. Pacific SW. Forest & Range Exp. Sta., Berkeley, Calif. 1967

[13]Banash et al. Op. cit.

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